

**CLAIMS**

1. An electro-thermal actuator device (1) comprising
- a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),
  - an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume of said expansible material (MD), and displacing said piston (7),
  - a shaft (3) capable of sliding following displacement of said piston (7),
  - electric terminals (11, 12) for supplying said heater (10),
- wherein
- said body (8) and said heater (10) are arranged in an inner cavity (Z1, Z2) of a casing (2) of the device (1),
  - said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of said cavity (Z1, Z2) through a passage formed at an end of said casing (2),
  - said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),
  - said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined, an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of said pieces,
- characterized in that sealing means (15, G; 31, G1;

31, G2; 31; R, 40) are provided, operatively arranged between said surfaces of junction (S) and cooperating with a respective piece (2A, 2B) of the casing (2) in order to hermetically insulate at least a part (Z2) of  
5 said inner cavity (Z1, Z2) with respect to the external environment.

2. Device according to claim 1, characterized in that each surface of junction (S) lies at least in part on a plan that crosses in an axial way said body  
10 (8) or said shaft (3).

3. Device according to claim 1, characterized in that said shaft (3) protrudes out of said casing (2) through a passage partly defined in a first one (2B) of said two pieces and partly defined in a second one  
15 (2A) of said two pieces.

4. Device according to claim 1, characterized in that in the surface of junction (S) of at least a first one (2B) of said two pieces a first seat (16, SG; 30, SG; 30, SG2; 30; SR) is defined, for partially  
20 housing sealing means (15, G; 31, G1; 31, G2; 31, R, 40).

5. Device according to claim 1, characterized in that in the surface of junction of the second piece (2A, 2B) a second seat (16, SG; 30, SG; 30, SG2; 30; SR) is defined, for partially housing sealing means  
25 (15, G; 31, G1; 31, G2; 31, R, 40).

6. Device according to claim 1, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31, R, 40) comprise an annular gasket (15, 31).

30 7. Device according to claim 5, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31, R, 40) comprise an annular gasket (15, 31) partly housed within said first seat and partly housed within said second seat.

35 8. Device according to claim 1, characterized in

that said casing (2) comprises at least one seat (16, 30), partially obtained in a first one (2B) of said two pieces and partially obtained in a second one (2A) of said two pieces, apt at housing sealing means of annular shape (15, 31).

9. Device according to claim 1, characterized in that in an area of said body (8) of the thermal actuator (6) a housing is defined (8A).

10. Device according to claim 9, characterized in that said housing (8A) has a circular development or shape.

11. Device according to claim 9, characterized in that said housing (8A) is located in an area of said body (8) close to a zone from which said piston (7) protrudes out of said body.

12. Device according to claim 9, characterized in that said housing (8A) has a shape of throat having a circular development.

13. Device according to claim 9, characterized in that said body (8), in correspondence of said housing (8A), has a circular section.

14. Device according to claim 9, characterized in that said housing (8A) is located close to a part of said body (8) having a quadrangular section or close to a part of said body (8) having flat faces.

15. Device according to claim 9, characterized in that said housing (8A) is located close to said heater (10).

16. Device according to claim 9, characterized in that said sealing means (15) are located close to said heater (10).

17. Device according to claim 9, characterized in that said sealing means comprise an annular gasket (15) mounted on or within said housing (8A).

18. Device according to claim 1, characterized in

that said cavity (Z1, Z2) is transversally subdivided into a first and a second zone (Z1, Z2) by means of an intermediate wall (2A', 2B'), in the first zone (Z1) being positioned said first portion (3A) of said shaft  
5 (3) and in the second zone (Z2) being positioned said heater (10), said first part of said terminals (11, 12) and at least a portion of said thermal actuator (6).

19. Device according to claim 18, characterized in  
10 that said intermediate wall is formed by the union of two half-walls (2A', 2B'), each half-wall (2A', 2B') being an integral part of a respective piece (2A, 2B) of said casing (2).

20. Device according to claim 5, characterized in  
15 that said first seat (16, SG; 30, SG; 30, SG2; 30; SR) comprises at least a first substantially semicircular housing (16) being defined in the surface of junction (S) of one of said two pieces (2A, 2B) of the casing (2) and that said second seat (16, SG; 30, SG; 30,  
20 SG2; 30; SR) comprises at least a substantially semicircular housing (16) being defined in the surface of junction of the other of said two pieces (2A, 2B).

21. Device according to claim 5, characterized in  
25 that said cavity (Z1, Z2) is transversally subdivided into a first and a second zone (Z1, Z2) by means of an intermediate wall (2A', 2B') formed by the union of two half-walls (2A', 2B'), each half-wall (2A', 2B') being an integral part of a respective piece (2A, 2B) of said casing (2), that said first seat (16, SG; 30,  
30 SG; 30, SG2; 30; SR) comprises at least a first substantially semicircular housing (16) being defined in the half-wall (2A', 2B') of one of said two pieces (2A, 2B) of the casing (2) and that said second seat (16, SG; 30, SG; 30, SG2; 30; SR) comprises at least a  
35 substantially semicircular housing (16) being defined

in the half-wall (2A', 2B') of the other piece (2A, 2B).

22. Device according to claim 1, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31; R, 40) comprise a sealing element (G; G1; G2; R, 40) which is arranged substantially parallel to the surfaces of junction (S) of said two pieces (2A, 2B) of the casing (2).

23. Device according to claim 4, characterized in that said first seat (SG; SG) extends along a limited part of the surface of junction (S) of the respective piece (2A, 2B) of the casing (2) and that said sealing means (15, G; 31, G1; 31, G2; 31; R, 40) comprise a first perimetral gasket (G; G1) partly housed in said first seat (SG; SG).

24. Device according to claim 23, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31; R, 40) further comprise an annular gasket (15) cooperating with said body (8) and that said first perimetral gasket (G) comprises two ends (EG) in contact with said annular gasket (15, 31).

25. Device according to claim 5, characterized in that said second seat (SG; SG) extends along a limited part of the surface of junction (S) of the respective piece (2A, 2B) of the casing (2) and that said sealing means (15, G; 31, G1; 31, G2; 31; R, 40) comprise a perimetral gasket (G; SG) partly housed in said second seat (SG; SG).

26. Device according to claim 4, characterized in that said first seat (SG2) extends along a prevailing part of the surface of junction (S) of the respective piece (2A, 2B) of the casing (2) and that said sealing means (15, G; 31, G1; 31, G2; 31; R, 40) comprise a perimetral gasket (G2) partly housed in said first seat (SG2).

27. Device according to claim 5, characterized in that said second seat (SG2) extends along a prevailing part of the surface of junction (S) of the respective piece (2A, 2B) of the casing (2) and that said sealing  
5 means (15, G; 31, G1; 31, G2; 31; R, 40) comprise a perimetral gasket (G2) partly housed in said second seat (SG2).

28. Device according to claim 1, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31; R,  
10 40) comprise at least one first perimetral gasket (G1) having a half-ring shaped portion (15A) and a perimetral sealing portion (G1').

29. Device according to claim 28, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31; R,  
15 40) comprise at least a second perimetral gasket (G1) having a half-ring shaped portion (15A) and a perimetral sealing portion (G1'), the first and second perimetral gasket (G1) being substantially specular and mating.

20 30. Device according to claim 4, characterized in that said first seat (16, SG; 30, SG; 30, SG2; 30; SR) comprises a substantially semicircular housing (30) defined in an end wall of the respective piece (2A, 2B) of the casing (2).

25 31. Device according to claim 5, characterized in that said second seat (16, SG; 30, SG; 30, SG2; 30; SR) comprises a substantially semicircular housing (30) defined in an end wall of the respective piece (2A, 2B) of the casing (2).

30 32. Device according to claim 31, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31, R, 40) comprise at least one annular gasket (31) operating a seal on said shaft (3) and positioned in correspondence of said semicircular housings (30).

35 33. Device according to claim 1, characterized in

that said sealing means (15, G; 31, G1; 31, G2; 31, R, 40) are obtained at least in part through a welding process of the surfaces of junction (S), or the pieces (2A, 2B) are made integral to each other through a melting and solidification process of material constituting the two pieces (2A, 2B).

34. Device according to claim 33, characterized in that said two pieces (2A, 2B) are reciprocally welded or made integral to each other through thermal melting or ultrasound welding.

35. Device according to claim 33, characterized in that said surface of junction (S) comprises at least a protrusion (R) integral with one of said two pieces (2A, 2B) of the casing (2) and inserted in said first seat (SR), that it is defined on the other one of said two pieces.

36. Device according to claim 4, characterized in that said sealing means (15, G; 31, G1; 31, G2; 31, R, 40) comprise a protrusion (R) integral with one of said two pieces (2A, 2B) of the casing (2) and inserted in said first seat (SR), which is defined on the other one of said two pieces.

37. Device according to claim 36, characterized in that said protrusion (R) has smaller dimensions than said first seat (SR), between said protrusion (R) and said first seat (SR) a space being formed for containing a material (40) capable of reciprocally sealing and/or sticking said two pieces (2A, 2B) of the casing (2), said material (40) being part of said sealing means (15, G; 31, G1; 31, G2; 31, R, 40).

38. Device according to claim 35, characterized in that said protrusion (R) and said first seat (SR) have substantially complementary shape and dimensions, or such to determine a minimal interference, and that in correspondence of the area of coupling between said

protrusion (R) and said first seat (SR) said two pieces of the casing are mutually welded.

39. Device according to claim 18, characterized in that within said second zone (Z2) an electrically  
5 insulating material (42) is present, and that at least one of said pieces (2A, 2B) of the casing (2) has a hole or passage (F1) for the injection of said electrically insulating material (42).

40. Device according to claim 39, characterized in  
10 that at least one of said pieces of the casing (2) has a hole or passage (F2) for air escape during the injection of said electrically insulating material (42).

41. Device according to claim 39, characterized in  
15 that said electrically insulating material (42) is capable of hardening and/or realizing a rigid body within the casing (2) after its injection, in particular a silicon material or a resin.

42. Device according to claim 18, characterized in  
20 that separation means (15, 2A', 2B', 41) are provided, acting for preventing infiltration of electrically insulating material (42) towards said first zone (Z1) of the cavity (Z1, Z2), in particular during an injection operation of the same material in said  
25 second zone (Z2) of said cavity.

43. Device according to claim 42, characterized in that said separation means (15, 2A', 2B', 41) comprise at least one gasket.

44. Device according to claim 42, characterized in  
30 that said separation means (15, 2A', 2B', 41) comprise said intermediate wall (2A', 2B').

45. Device according to claim 42, characterized in that said separation means (15, 2A', 2B', 41) comprise two half-walls (2A', 2B'), each half-wall being an  
35 integral part of a respective piece (2A, 2B) of said



casing (2), said intermediate wall being formed by the union of said half-walls (2A', 2B').

46. Device according to claim 1, characterized in that additional sealing means are provided, for  
5 preventing infiltrations towards the inside of said cavity (Z1, Z2) along said terminals (11, 12).

47. Device according to claim 46, characterized in that said additional sealing means comprise an insulating material arranged outside said casing (2)  
10 and around a part of said second portion of the terminals (11, 12).

48. Device according to claim 47, characterized in that in the piece of the casing (2) from which said second portion of the terminals (11, 12) protrudes  
15 out, there are provided one or more seats (50) for containing said insulating material (50).

49. Device according to claim 46, characterized in that said additional sealing means comprise a projection or a tubular portion (18) of the piece of  
20 the casing (2) from which said second portion of the terminals (11, 12) protrudes out, the latter lying at least partly within said tubular portion (18).

50. Device according to claim 49, characterized in that said additional sealing means comprise an  
25 external sealing member (19), which is internally hollow, at least partly elastic and partially mounted on said tubular portion (18).

51. Device according to claim 50, characterized in that said external sealing member (19) is operative  
30 for performing a seal on an electric cable for supplying said heater (10).

52. Device according to claim 46, characterized in that said additional sealing means comprise at least an elastic sealing element (20) having a respective  
35 slit in which a part of a terminal (11, 12) passes

through, the elastic sealing element (20) carrying out a seal between said terminal (11, 12) and the piece of the casing (2) from which said second portion of said terminals (11, 12) protrudes.

5        53. Device according to claim 18, characterized in that said first portion of the shaft (3A) has a concavity capable of housing a front area of said body (8) which protrudes into said first zone (Z1).

10        54. Device according to claim 6, characterized in that said annular gasket (31) operates a seal on said shaft (3) and that the latter, at least in the area cooperating with said annular gasket (31), is free from longitudinal burrs or lines of junction.

15        55. Device according to claim 1, characterized in that said heater (10) is a positive temperature coefficient resistor having circular or rectangular shape.

56. An electro-thermal actuator device (1) comprising

20        - a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),

25        - an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume of said expansible material (MD), and displacing said piston (7),

30        - a shaft (3) capable of sliding following displacement of said piston (7),

      - electric terminals (11, 12) for supplying said heater (10),

      wherein

35        - said body (8) and said heater (10) are arranged in an inner cavity (Z1, Z2) of a casing (2) of the

device (1),

- said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of  
5 said cavity (Z1, Z2) through a passage formed at an end of said casing (2),

- said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),

10 - said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined, an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of  
15 said pieces,

characterized in that at least a seat is defined (16, 30) in said casing (2), partially obtained in a first one (2B) of said two pieces and partially obtained in a second one (2A) of said two pieces, said  
20 seat (16, 30) being capable of cooperating with annular shaped sealing means (15, 31).

57. Device according to claim 56, characterized in that said annular sealing means (15, 31) perform a seal which is at least partly radial on at least one  
25 between said body (8) and said shaft (3).

58. An electro-thermal actuator device (1) comprising

- a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a  
30 piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),

- an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume  
35 of said expansible material (MD), and displacing said

piston (7),

- a shaft (3) capable of sliding following displacement of said piston (7),

- electric terminals (11, 12) for supplying said  
5 heater (10),

wherein

- said body (8) and said heater (10) are arranged in an inner cavity (Z1, Z2) of a casing (2) of the device (1),

- 10 - said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of said cavity (Z1, Z2) through a passage formed at an end of said casing (2),

- 15 - said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),

- said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined,  
20 an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of said pieces,

- characterized in that sealing means (15, G; 31, G1;  
25 31, G2; 31; R, 40) are provided, for hermetically insulating at least a part (Z2) of said inner cavity (Z1, Z2) , comprising at least an annular gasket (15, 31), which is partly housed in a first seat obtained in a first one (2B) of said two pieces, and partly  
30 housed in a second seat, obtained in a second one (2A) of said two pieces.

59. An electro-thermal actuator device (1) comprising

- a thermal actuator (6) having a body (8)  
35 containing a thermally expansible material (MD), a

piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),

5       - an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume of said expansible material (MD), and displacing said piston (7),

      - a shaft (3) capable of sliding following displacement of said piston (7),

10       - electric terminals (11, 12) for supplying said heater (10),

      wherein

15       - said body (8) and said heater (10) are arranged in an inner cavity (Z1, Z2) of a casing (2) of the device (1),

20       - said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of said cavity (Z1, Z2) through a passage formed at an end of said casing (2),

      - said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),

25       - said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined, an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of said pieces,

30       characterized in that only within said second zone (Z2) an electrically insulating material (42) is present, which is injected into said cavity (Z1, Z2) after the coupling or junction of said two pieces (2A, 2B), and that there are provided sealing or separation  
35       means (15, 2A', 2B', 41) for preventing infiltrations

of said electrically insulating material (42) towards said first zone (Z1).

60. An electro-thermal actuator device (1) comprising

- 5       - a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),
- 10       - an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume of said expansible material (MD), and displacing said piston (7),
- a shaft (3) capable of sliding following  
15 displacement of said piston (7),
- electric terminals (11, 12) for supplying said heater (10),
- wherein
- said body (8) and said heater (10) are arranged  
20 in an inner cavity (Z1, Z2) of a casing (2) of the device (1),
- said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of  
25 said cavity (Z1, Z2) through a passage formed at an end of said casing (2),
- said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),
- 30       - said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined, an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of  
35 said pieces,

characterized in that said two pieces (2A, 2B) are welded or made integral to each other for sealing purposes by means of a process of melting and solidification of material constituting the two pieces  
5 (2A, 2B).

61. Device according to claim 60, characterized in that said two pieces (2A, 2B) are welded or made integral by means of thermal melting or ultrasound welding.

10 62. An electro-thermal actuator device (1) comprising

- a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a piston (7) partially dipped into said expansible  
15 material and seal means (MT) operating between said body (8) and said piston (7),

- an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume of said expansible material (MD), and displacing said  
20 piston (7),

- a shaft (3) capable of sliding following displacement of said piston (7),

- electric terminals (11, 12) for supplying said heater (10),

25 wherein

- said body (8) and said heater (10) are arranged in an inner cavity (Z1, Z2) of a casing (2) of the device (1),

- said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of said cavity (Z1, Z2) through a passage formed at an  
30 end of said casing (2),

- said terminals (11, 12) have each a first part  
35 positioned within said cavity (Z1, Z2) and a second

part protruding out of said cavity (Z1, Z2),

- said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined, an area of junction being present between said pieces  
5 (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of said pieces,

characterized in that a housing (8A) is defined on said body (8) for positioning respective sealing means  
10 (15; 15'), said sealing means (15; 15') cooperating for sealing purposes between said body (8) and a respective piece (2A, 2B) of the casing (2).

63. An electro-thermal actuator device (1) comprising

15 - a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),

20 - an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume of said expansible material (MD), and displacing said piston (7),

- a shaft (3) capable of sliding following  
25 displacement of said piston (7),

- electric terminals (11, 12) for supplying said heater (10),

wherein

- said body (8) and said heater (10) are arranged  
30 in an inner cavity (Z1, Z2) of a casing (2) of the device (1),

- said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of  
35 said cavity (Z1, Z2) through a passage formed at an



end of said casing (2),

- said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),

5       - said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined, an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of  
10 said pieces,

characterized in that in the surface of junction (S) of at least a first one (2B) of said two pieces a first seat (16, SG; 30, SG; 30, SG2; 30; SR) is defined, for partially housing sealing means (15, G;  
15 31, G1; 31, G2; 31, R, 40).

64. Device according to claim 63, characterized in that in the surface of junction (S) of the second piece (2A, 2B) a second seat (16, SG; 30, SG; 30, SG2; 30; SR) is defined for partially housing said sealing  
20 means (15, G; 31, G1; 31, G2; 31, R, 40).

65. An electro-thermal actuator device (1) comprising

- a thermal actuator (6) having a body (8) containing a thermally expansible material (MD), a  
25 piston (7) partially dipped into said expansible material and seal means (MT) operating between said body (8) and said piston (7),

- an electric heater (10), capable of heating said body (8) in order to cause an increase in the volume  
30 of said expansible material (MD), and displacing said piston (7),

- a shaft (3) capable of sliding following displacement of said piston (7),

- electric terminals (11, 12) for supplying said  
35 heater (10),

wherein

- said body (8) and said heater (10) are arranged in an inner cavity (Z1, Z2) of a casing (2) of the device (1),
- 5       - said shaft (3) has a first portion (3A) constantly arranged within said cavity (Z1, Z2) and a second portion capable of come out to the outside of said cavity (Z1, Z2) through a passage formed at an end of said casing (2),
- 10       - said terminals (11, 12) have each a first part positioned within said cavity (Z1, Z2) and a second part protruding out of said cavity (Z1, Z2),
  - said casing (2) is formed by at least two half-shells or pieces (2A, 2B) mutually coupled or joined,
  - 15       an area of junction being present between said pieces (2A, 2B), which area is formed by two facing surfaces of junction (S), each surface pertaining to one of said pieces,
  - an annular gasket (15, 31) is provided, which
  - 20       cooperates, on the one side, with at least one between said body (8) and said shaft (3) and, on the other side, with at least one of said pieces (2A, 2B) in order to hermetically insulate at least a part (Z2) of said inner cavity (Z1, Z2) with respect to the
  - 25       external environment,
  - said surfaces of junction (S) are mutually welded or made integral to each other through a process of melting and solidification of material constituting said two pieces (2A, 2B).

30